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Age-Class Interactions in Atlantic Salmon and Brown Trout

Effects on Habitat use and Performance

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The oral defence of this thesis will take place at 10:00 am on Thursday 27 May 2010, at the Department of Zoology, Medicinaregatan 18, Göteborg, Sweden. The opponent is Professor James W. A. Grant from Concordia University, Montréal, Quebec, Canada.

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ABSTRACT

This thesis investigates the underlying mechanisms and the density-regulatory effects of age-class interactions, using juvenile Atlantic salmon (*Salmo salar* L.) and brown trout (*Salmo trutta* L.) as study species. Field experiments were performed in streams along the western coast of Sweden, in which densities of older age-classes were reduced and the response on young-of-the-year habitat use and performance (growth, movement and survival) was observed (Papers **I** and **II**). Observational data from 159 trout populations was extracted from the Swedish Electro-fishing Register to test the generality of age-class competition (Paper **III**) and observations in controlled artificial stream environments were used to establish the underlying mechanisms with regard to habitat use and behavioural interactions (Papers **IV** and **V**).

The combined findings of these studies show that age-classes of stream-living salmonids compete for limited resources in the stream habitat. This competition favours old individuals, although the behavioural observations of Paper **V** suggest that their competitive benefit may decrease at increasing densities of young-of-the-year fish.

Density-reductions of older cohorts in field increased the growth of young-of-the-year trout, an effect that was observed at the later part of the growth season (Papers **I** and **II**). The observational data-set (Paper **III**), provided further evidence of the prevalence of inter-cohort competition, reflected as a negative association between density of older cohorts and young-of-the-year body-size, in the same magnitude as on an intra-cohort level. In accordance with previous studies, juvenile salmon and trout were segregated in the stream habitat, with young-of-the-year individuals using shallow, low-velocity, habitats close to the spawning area while older cohorts were positioned in deep, high-velocity, areas (Papers **II** and **IV**). However, when experimentally reducing the density of older cohorts in field and lab (Papers **II** and **IV**), this spatial pattern was shown to be an effect of habitat exclusion rather than size-dependent habitat preference, as suggested in previous studies, with subsequent negative effects on young-of-the-year foraging activity (Paper **IV**). Thus, this finding provides a potential underlying mechanism to the negative effect on young-of-the-year performance presented in Papers **I**, **II** and **III**.

From an applied point of view, the findings of this thesis highlight the importance of taking age-class interactions into account when investigating density-dependence and habitat use among stream-living salmonids. The findings also suggest that marginal stream habitats may be essential during the first months after emergence by acting as refuges from inter-cohort competition, thus emphasizing the importance of maintaining and restoring these habitats in the wild.

KEYWORDS: Competition, inter-cohort, density-dependence, growth, habitat, *Salmo trutta*, *Salmo salar*, trout, salmon

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